AEROLOGICAL OBSERVATIONS FOR JULY

[Aerological Division, D. M. LITTLE in charge]

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The 677 airplane and radiosonde upper-air observations of pressure, temperature, and humidity, shown in tables 1 and 1a, were made in the United States, Virgin Islands, Canal Zone, and Hawaii, during July 1939. The month brought about several changes, for airplane observations at Chicago, Ill., and El Paso, Tex., and the radiosonde work at Fargo, N. Dak., were discontinued. Radiosonde observations were inaugurated at Atlanta, Ga., Bismarck, N. Dak., Charleston, S. Car., Denver, Colo., El Paso, Tex., Joliet, Ill., and Miami, Fla. Charts VIII–A, IX–A, X–A, and XI–A show the distribution of mean free-air pressures and temperatures, as well as resultant wind directions and forces. Chart XII–A gives the July isentropic data, tables 2 and 3 list the winds for certain stations, and table 4 shows the heights of the various tropopauses.

Mean free-air pressures for July are shown on charts VIII–A, IX–A, X–A, and XI–A. At 5,000 feet (chart VIII–A) the pressure was lowest over the western Rocky Mountain region, and from Newfoundland (844.8 millibars) to western Canada (845.1 millibars). The lowest mean pressures in the United States occurred over Whiteface Mountain, N. Y. (845.7 millibars), Sault Ste. Marie, Mich., and southeastern Idaho (847.6 millibars). Highest pressure prevailed over the Southeast, being centered generally at Pensacola and Miami, Fla. (853.6 millibars).

At 3, 4, and 5 kilometers (charts IX–A, X–A, and XI–A) lowest mean pressure recorded during the month continued over southern Canada and the northern United States (Sault Ste. Marie, Mich., 708, 626, and 551 millibars, respectively). At these three upper levels the highest pressure prevailed over the South, being centered over Pensacola, Fla., while at 5 kilometers equal pressures persisted over Oklahoma City, Okla., and Miami, Fla.

The July mean pressure was higher than any recorded throughout the preceding months since August 1938, when radiosonde observations were inaugurated at 7 stations in the United States. Pressures noted during the preceding month of June were nearly as high, and these, together with those for the current month as well as August 1938, when combined to make up the summer season, indicated that the upper-air pressures were higher than at any other season of the year. July mean pressures in the lower levels were generally less than those recorded in August 1938, while above 6 kilometers the current pressures over Nashville, Tenn., Oakland, Calif., Oklahoma City, Okla., Omaha, Nebr., and Sault Ste. Marie, Mich., were higher than those noted in any previous month. However, at Washington, D. C., most of the July mean pressures were equalled or exceeded by those recorded in August 1938 and June 1939.

A study of July radiosonde mean upper-air pressures within the United States indicated that the existing gradient or difference in millibars at each level between the LOW and HIGH areas (Sault Ste. Marie, Mich., and Miami, Fla., respectively) increased steadily with altitude from 5 millibars at 1 kilometer to 12 millibars at 11 kilometers, and then decreased uniformly to a difference of only 1 millibar at 20 kilometers.

The month of July was characterized by high surface temperatures (°F.) over the United States except in the East and particularly the Middle Atlantic coast. Between the Mississippi River and the Rocky Mountains from Texas to Canada, abnormally high temperatures, ranging from 4° to 8° F. above normal, persisted during the month. Westward of this region the temperatures were moderately above normal. Mean temperatures (°C.) in the upper air during July were higher than throughout most of the preceding months of the fiscal year. The highest mean temperatures for the month were noted over the Central States and the southern Rocky Mountain region at 1.5, 3, and 4 kilometers, and over the Southeast at 5 kilometers. Low mean temperatures occurred over the Northeast and Newfoundland, as well as in the far Northwest, at all levels up to 5 kilometers. In the United States the lowest mean temperatures from the surface up to 3 kilometers were found over Sault Ste. Marie, Mich., but those recorded at Seattle, Wash., were considerably lower at 4 kilometers.

In the higher levels where observations are made by radiosondes, warmest free-air temperatures were located over Miami, Fla. However, these quickly shifted to Charleston, S. C., above 7 kilometers, with Miami, Fla., and El Paso, Tex., nearly as warm. But at 14 kilometers, Sault Ste. Marie, Mich., became the warmest station for the country and continued to be so at the maximum level reached –20 kilometers. In these higher levels Bismarck, N. Dak., was nearly as warm as Sault Ste. Marie, Mich., and Oakland, Calif., also encountered warm levels at 12, 13, 14, and 15 kilometers. The coldest free-air temperatures in the upper levels were noted over Sault Ste. Marie, Mich., from 1 to 11 kilometers, with Bismarck, N. Dak., recording slightly warmer temperatures. Above 11 kilometers, El Paso, Tex., was the coldest station, with Atlanta, Ga., Charleston, S. C., and Miami, Fla., only slightly warmer. But at 18 kilometers Miami, Fla., became the coldest in the United States up to a maximum altitude of 21 kilometers.

The lowest *mean* free-air temperature recorded in July was —72.2° C. over El Paso, Tex., at 16 kilometers, and the lowest *individual* temperature during the month was —75.0° C. on the 18th over Charleston, S. C., at 17 kilometers. Another low individual temperature of —73.5° C. occurred on the same date over Atlanta, Ga. (17 kilometers), and El Paso, Tex. (16 kilometers). Low temperatures also were reported on the 12th over Miami, Fla. (—74.2° C.); on the 9th at Oklahoma City, Okla., and the 7th over Nashville, Tenn. (—74.2° C.); Oakland, Calif. (—73.4° C.) on the 19th; and on the 7th at Washington, D. C. (—72.0° C.); all occurring at 16 kilometers.

Mean relative humidity for July was lowest over Oakland, Calif., and highest over El Paso, Tex. Low mean humidities in the lower levels (below 5 kilometers) occurred over San Diego, Calif., Oakland, Calif., Salt Lake City, Utah, Cheyenne, Wyo., and Spokane, Wash., all far western stations, while high humidities centered over Sault Ste. Marie, Mich., Nashville, Tenn., Wash., D. C., Norfolk, Va., Charleston, S. C., and Pensacola, Fla., all eastern and southeastern stations. At all stations (tables 1 and 1a), except two, the mean relative humidity was highest in the lower levels and lowest in the higher levels. The exceptions occurred at Denver, Colo., and El Paso, Tex., where just the reverse was true.

Upper-air wind observations by means of pilot balloons were being conducted at 97 stations within the United States during July. The larger 100-gram balloons were

in use at 23 of these stations, and higher altitudes were being reached. Helium gas replaced hydrogen at all pilot and sounding balloon stations throughout the United States proper in July. The 5 a. m. (E. S. T.) observations are indicated on charts VIII–A and IX–A, while those for 5 p. m. are shown on charts X–A and XI–A. Table 2 lists the 5 p. m. (E. S. T.) resultant winds at a number of selected stations, and table 3 shows the highest individual wind speeds recorded during the month.

A well-defined resultant-wind circulation over the southern and central portions of the country at 1.5 kilometers is shown on chart VIII–A. This circulation veered to the East and became westerly and northwesterly in the North, and to the east of the Mississippi Valley. Over this latter portion of the United States, as well as to the North and Northwest, and in Canada, winds from the northwest quadrant were found to predominate at all levels. But at 3, 4, and 5 kilometers, the southerly winds spread farther West so as to include the Pacific coast. Northwesterly winds occurred in 47, 50, 52, and 48 percent of all cases at 1.5, 3, 4, and 5 kilometers, respectively, while southwesterly winds were noted in 41, 37, 35, and 40 percent of all observations at the same levels, respectively. Resultant wind directions from the southeast quadrant occurred at all levels over Cuba, Mexico, southern Florida, and the west Gulf region. The percentage of winds from the northeast quadrant increased with altitude, being 1, 4, 5, and 11 percent of all cases at 3, 4, 5, and 6 kilometers, respectively.

Resultant wind velocities were highest at all levels over the northern and eastern sections of the country, southwest of the Great Lakes, and in the southwest Gulf region. At 1.5 kilometers highest velocities were confined to Texas, where Amarillo, Brownsville, and Del Rio, showed resultant wind speeds of 9.8, 9.4, and 9.3 meters per second, respectively. At 3 kilometers, greatest velocities were noted over Kylertown and Harrisburg, Pa., and Washington, D. C. (8.3, 7.5, and 7.5 meters per second, respectively). Highest resultant velocities at 4 kilometers were noted over the region south of the Great Lakes, and over Des Moines, Iowa, Indianapolis, Ind., Moline, Ill., and Chicago, Ill. (12.0, 11.9, 10.7, and 10.6 meters per second, respectively). This same localized area, as well as that immediately to the northwest, showed the highest velocities at 5 kilometers to be over Indianapolis, Ind., Fargo, N. Dak., Des Moines, Iowa, Cincinnati, Ohio, Minneapolis, Minn., Havre, Mont., and Bismarck, N. Dak. (13.5 13.3, 12.8, 12.7, 12.5, 12.4, and 12.4 meters per second, respectively).

Comparing the 5 a. m. (E. S. T.) July resultant directions with established 5 a. m. normals computed for a selected list of stations in the United States, it was found that the current winds departed widely from normal at 1.5 kilometers over Chicago, Ill., and at 3 kilometers over Oklahoma City, Okla. These variations were 84° and 62°, respectively. The current directions at both 1.5 and 3 kilometers over Houston, Tex., Medford, Oreg., Oakland, Calif., Sault Ste. Marie, Mich., Seattle, Wash., and Washington, D. C., departed by backing away from the normals. But at New Orleans, La., Jacksonville and Key West, Fla., Nashville, Tenn., St. Louis, Mo., and Spokane, Wash., all departures at these two levels were oriented by clockwise rotations from the normal. Velocity departures were not outstanding during July, but at 3 kilometers, over Sault Ste. Marie, Mich., and Nashville, Tenn., the velocities departed from normal by −4.6 m. p. s. and +3.0 m. p. s., respectively.

Larger departures from normal were noted when comparing the 5 p. m. July resultants with the 5 a. m. established normals for 4 and 5 kilometers. The current directions departed from normal in a clockwise rotation over Atlanta, Ga., Fargo, N. Dak., Nashville, Tenn., San Diego, Calif., New Orleans, La., and Jacksonville, Fla. The greatest departures at 4 and 5 kilometers occurred over Oklahoma City, Okla. (99° clockwise and 169° counterclockwise, respectively). Counterclockwise departures from normal were noted at Billings, Mont., Cincinnati, Ohio, Houston, Tex., Omaha, Nebr., Salt Lake City, Utah, Sault Ste. Marie, Mich., and Seattle and Spokane, Wash. The 5 p. m. velocities were generally higher than the 5 a. m. normals over most stations at 4 and 5 kilometers. With the exception of San Diego, Calif., all stations showed positive or excess departures from normal velocity at 5 kilometers. Departures at St. Louis, Mo., Nashville, Tenn., Cincinnati, Ohio, and Chicago, Ill. (stations in the same area), were the largest for the month at 4 kilometers, being +5.7, +5.6, +5.5, and +4.2 meters per second, respectively. At 5 kilometers, outstanding departures were confined also to the same region, being +10.1, +6.1, +4.3, and +3.6 meters per second at Cincinnati, Ohio, Fargo, N. Dak., Nashville, Tenn., and Omaha, Nebr., respectively.

Considerable diurnal differences were noted between the 5 a. m. and corresponding 5 p. m. resultants, at 1.5 and 3 kilometers. At 1.5 kilometers, over all stations for which 5 p. m. resultants are computed (table 2), it was noted that the p. m. winds for July had directions that varied by counterclockwise departures from the a. m. wind directions. At Billings, Mont., Salt Lake City, Utah, Sault Ste. Marie, Mich., New Orleans, La., Miami, Fla., and Little Rock, Ark., the 5 p. m. winds departed from the a. m. in clockwise rotations. At 3 kilometers, however, many of the 5 p. m. directions were separated from the 5 a. m. by clockwise orientations. At these 38 stations, the 5 p. m. winds departed from the a. m. directions by an average of 26° at both the 1.5 and 3 kilometer levels. The resultant velocities at 1.5 kilometers averaged lower at 5 p. m. than at 5 a. m., but at 3 kilometers, the afternoon velocities were higher in nearly all cases, particularly at Sault Ste. Marie, Mich. (+4.3 m. p. s.), Chicago, Ill. (+3.7 m. p. s.), and St. Louis, Mo. (+2.9 m. p. s.).

Maximum altitudes reached by pilot balloons during July showed improvement. All stations reached 6 kilometers; 52 percent exceeded 10 kilometers; 27 percent attained 15 kilometers; but only 1 percent exceeded 20 kilometers. The 5th, 13th, 14th, 15th, 22d, and 31st of July were favorable for long balloon observations. The highest altitude was reached over Huron, S. Dak., on the 18th, and at other places over Florida, west of the Mississippi, and in the southern Rocky Mountains.

This increase in high balloon observations again brought to attention the fact that easterly winds are frequent at the higher levels. Twenty-eight percent of all balloon flights ended with their maximum altitudes in winds having easterly tendencies, and of these easterly winds, 60 percent were from the northeast quadrant. In these cases winds from the southeast quadrant were encountered at 12, 13, 14, and 15 kilometers, while northeasterly directions predominated at 16, 17, and 18 kilometers. The highest elevation reached, that over Huron, S. Dak., showed an east wind at 20.7 kilometers.

Table 3 shows individual maximum wind speeds for July. The maximum of 36.4 meters per second indicated

over Sault Ste. Marie, Mich., at 2,480 meters, was one of the lowest maxima to be recorded in recent years below 2.5 kilometers. But, at Redding, Calif., the velocity of 84.0 meters per second at 19.7 kilometers, occurring on the 6th, was exceeded only three times elsewhere, and equaled in April and May of this year over the same station.

MEAN MONTHLY ISENTROPIC CHART [1]

The mean isentropic chart, $\theta=315°$, for July 1939 (chart XII–A), shows an anticyclonic eddy over the south-central part of the country. The westerlies are displaced southward over the Northeastern States. Because of the inadequacy of the data during this month of transition from airplane to radiosonde observations, the isentropic pattern is not sufficiently certain to undertake correlation with the precipitation departures. However, it may be noted that the displacement of the westerlies southward over the Northeast was accompanied by drought conditions in August 1934, as well as in this month.

[1] Prepared by the Division of Research and Education.

TABLE 1.—*Mean free-air barometric pressures (P.) in mb., temperatures (T.) in °C., and relative humidities (R. H.) in percent obtained by airplanes during July 1939*

Stations and elevations in meters above sea level	Altitude (meters) m. s. l.																											
	Surface				500			1,000			1,500			2,000			2,500			3,000			4,000			5,000		
	Number of observations	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.
Billings, Mont. (1,090 m.)	31	892	19.2	55							850	21.1	45	802	18.9	42	757	15.7	41	713	11.8	44	632	3.9	53	558	−3.8	59
Cheyenne, Wyo.[1] (1,873 m.)	15	815	17.2	48										803	20.3	42	759	19.2	36	715	15.6	36	635	7.8	40	561	−1.2	47
Coco Solo, C. Z.[2] (15 m.)	28	1,010	26.1	90	957	24.2	86	904	22.0	82	854	19.8	80	806	17.7	77	760	15.8	66	717	13.5	63	636	8.2	68			
Lakehurst, N. J.[2] (39 m.)	29	1,011	19.1	86	958	20.1	72	901	17.6	71	852	14.5	72	803	11.6	71	756	8.8	69	712	6.4	64	629	1.4	52	555	−3.1	54
Norfolk, Va.[2] (10 m.)	23	1,016	22.5	91	960	22.2	74	906	19.7	73	855	16.4	78	806	13.3	77	760	10.6	71	715	7.9	69	633	3.2	50	559	−3.2	42
Pearl Harbor, T. H.[2] (6 m.)	31	1,016	22.8	79	960	19.9	78	906	16.1	83	854	13.5	78	804	11.5	65	758	10.0	47	714	7.5	36	631	2.7	22			
Pensacola, Fla.[2] (13 m.)	30	1,015	24.0	94	961	25.0	74	907	22.0	72	856	19.3	70	807	16.6	69	762	14.0	67	718	11.6	61	637	6.0	66	562	0.6	62
St. Thomas, V. I.[2] (8 m.)	31	1,018	27.9	74	964	23.6	88	910	20.2	90	858	17.5	82	810	15.2	72	763	12.8	61	718	10.0	56	636	4.2	52			
Salt Lake City, Utah[3] (1,288 m.)	22	871	19.1	45							850	24.9	36	802	22.7	32	758	19.0	32	714	14.8	33	634	6.5	37	560	−2.2	42
San Diego, Calif.[2] (10 m.)	30	1,012	20.2	80	958	16.9	88	903	22.6	56	852	23.8	38	805	21.4	35	759	18.3	33	716	14.8	33	635	7.4	32	561	−0.8	36
Seattle, Wash.[2] (10 m.)	28	1,017	17.4	71	960	13.7	77	905	12.7	64	853	11.3	56	803	8.9	53	756	6.3	49	711	3.6	40	628	−2.9	38			
Spokane, Wash. (597 m.)	31	945	16.2	56				902	20.8	40	851	18.3	38	802	14.1	41	756	10.1	44	711	6.4	47	629	−0.4	46	554	−7.0	42

[1] Observations terminated July 15, 1939.
[2] Navy.
[3] Observations terminated July 23, 1939.

Observations taken about 4 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

TABLE 1a.—*Mean free-air barometric pressures (P.) in mb., temperatures (T.) in ° C., and relative humidities (R. H.) in percent obtained by radiosondes during July 1939*

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																											
	Atlanta, Ga.[1] (298 m.)				Bismarck, N. Dak.[1] (508 m.)				Charleston, S. C.[1] (14 m.)				Denver, Colo.[1] (1,616 m.)				El Paso, Tex.[2] (1,194 m.)				Joliet, Ill. (178 m.)				Miami, Fla.[1] (4 m.)			
	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.
Surface	26	982	21.9	88	23	956	18.7	71	17	1,013	23.4	93	19	840	19.2	53	30	883	23.7	53	31	994	18.4	90	20	1,017	24.0	91
500	26	959	22.7	80					17	959	23.4	79									31	958	22.1	70	20	961	23.4	82
1,000	26	906	21.2	76	23	903	21.4	54	17	905	21.0	75									31	904	20.7	68	20	907	20.8	80
1,500	26	855	18.0	76	23	852	19.4	50	17	854	18.5	78					30	852	23.4	49	31	853	17.8	69	20	856	17.9	73
2,000	26	806	15.2	71	23	804	16.4	50	17	806	15.3	78	19	803	20.4	41	30	804	20.9	49	31	804	15.0	68	20	807	15.5	64
2,500	26	760	12.9	67	23	757	13.4	51	17	760	12.6	73	19	758	18.4	43	30	759	17.5	51	31	758	12.3	62	20	761	13.2	58
3,000	26	715	10.2	63	23	713	10.2	50	17	715	9.7	68	19	714	15.8	43	30	716	13.8	56	31	714	9.9	55	20	717	10.5	54
4,000	26	634	4.2	59	23	632	3.7	48	17	634	4.0	64	18	634	8.0	45	30	635	6.1	68	30	632	4.4	51	20	635	5.2	51
5,000	26	560	−1.4	53	23	558	−3.8	47	17	560	−1.5	67	18	561	−0.1	48	30	561	−0.9	75	30	559	−1.3	46	20	562	−0.3	47
6,000	26	494	−6.9	49	23	490	−10.7	46	17	493	−6.6	62	18	494	−7.8	51	20	495	−7.5	75	30	492	−7.6	45	20	495	−6.5	45
7,000	26	434	−13.3	45	23	430	−17.9	43	17	434	−12.4	56	18	434	−16.1	48	20	435	−13.2	69	29	432	−14.1	43	20	435	−12.8	43
8,000	26	380	−19.8	40	23	376	−25.6	42	17	380	−19.0	52	18	380	−22.1	46	20	380	−19.6	67	28	378	−21.5	40	19	381	−19.1	46
9,000	26	330	−27.2	39	23	326	−33.0	40	17	331	−26.3	49	18	331	−30.0	45	20	332	−26.6	67	28	329	−29.0	39	19	332	−26.5	46
10,000	25	288	−34.8	38	23	282	−40.5		17	288	−33.9	47	17	287	−37.6	46	20	289	−34.4	65	28	286	−36.2	39	19	289	−34.3	44
11,000	24	248	−42.9		21	243	−47.6		17	249	−41.9		17	247	−45.1		20	250	−42.4		28	247	−43.6		19	250	−42.1	
12,000	24	214	−50.4		21	209	−53.2		17	214	−49.2		17	213	−51.8		20	215	−50.5		26	212	−50.3		19	215	−49.5	
13,000	24	183	−57.0		21	178	−57.1		16	184	−56.3		17	183	−57.5		20	184	−58.5		24	182	−55.7		19	184	−56.6	
14,000	24	156	−62.6		21	152	−60.0		16	156	−62.6		16	155	−62.5		20	157	−65.5		23	155	−60.0		19	157	−62.2	
15,000	24	132	−66.8		21	129	−62.0		16	132	−66.9		16	132	−65.8		19	133	−70.2		20	132	−62.0		19	133	−66.1	
16,000	24	112	−68.5		21	110	−62.0		15	112	−69.0		15	112	−66.2		18	112	−72.2		20	113	−62.9		18	113	−69.0	
17,000	23	95	−68.5		20	93	−60.6		14	95	−67.8		14	95	−65.6		17	94	−71.3		19	95	−63.3		17	95	−70.2	
18,000	22	80	−66.5		18	80	−59.4		9	80	−65.6		10	81	−63.5		16	80	−68.1		15	81	−62.2		17	80	−69.2	
19,000	18	68	−63.8		9	68	−57.8		8	68	−64.7		6	68	−61.8		13	68	−65.2		7	69	−61.5		13	68	−67.0	
20,000	13	58	−60.9		6	57	−55.6		5	57	−64.5						7	57	−62.4						8	58	−64.8	
21,000	5	49	−59.2																						6	49	−63 0	
22,000																												

See footnotes at end of table.

TABLE 1a.—*Mean free-air barometric pressures (P.) in mb., temperatures (T.) in ° C., and relative humidities (R. H.) in percent obtained by radiosondes during July 1939*—Continued

Stations and elevations in meters above sea level—Continued

Altitude (meters) m. s. l.	Nashville, Tenn. (180 m.)				Oakland, Calif. (2 m.)				Oklahoma City, Okla. (391 m.)				Omaha, Nebr. (300 m.)				Sault Ste. Marie, Mich. (221 m.)				Washington, D. C.[3] (7 m.)			
	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.	Number of observations	P.	T.	R. H.
Surface	31	994	22.0	87	31	1,015	14.4	84	31	969	23.6	70	31	979	22.2	79	30	988	12.8	93	28	1,015	20.3	87
500	31	958	22.8	75	31	957	14.7	76	31	957	25.1	62	31	957	23.3	68	30	956	16.2	78	28	959	19.2	73
1,000	31	905	21.1	73	31	903	21.0	43	31	904	25.6	51	31	904	22.9	58	30	902	15.6	71	28	905	16.7	71
1,500	31	854	18.0	75	31	852	20.1	34	31	854	22.6	50	31	854	20.3	54	30	850	12.5	73	28	853	13.9	68
2,000	31	806	15.2	72	31	803	17.6	31	31	805	19.5	49	31	805	18.0	48	30	800	9.2	74	28	804	11.0	68
2,500	31	759	12.8	61	31	757	14.7	31	31	760	16.1	48	31	759	14.9	47	30	753	6.4	70	28	757	8.1	66
3,000	31	715	10.5	56	31	714	11.8	30	31	716	12.6	47	31	715	11.5	46	30	708	3.9	63	27	712	5.5	64
4,000	30	634	4.4	52	31	633	5.4	31	31	635	5.6	50	31	634	4.5	47	30	626	−1.7	56	27	630	1.2	55
5,000	30	560	−1.9	51	31	559	−1.4	32	31	562	−1.2	45	30	560	−2.4	49	30	551	−7.1	49	26	555	−3.7	48
6,000	30	493	−7.8	49	31	492	−8.0	28	31	495	−7.7	39	30	493	−8.8	46	29	484	−13.4	45	26	488	−9.5	44
7,000	30	433	−13.8	44	31	432	−15.1	26	31	435	−13.9	34	30	432	−15.4	42	29	424	−20.2	44	25	429	−15.2	40
8,000	30	379	−20.5	42	31	378	−22.6	26	31	380	−20.4	34	30	378	−22.5	40	29	370	−27.7	43	24	375	−21.7	45
9,000	30	330	−27.7	39	31	329	−30.1	26	31	331	−27.4	32	30	329	−29.6	39	29	321	−35.6	42	23	327	−28.8	44
10,000	30	287	−35.4	39	31	285	−37.1	25	31	288	−35.2	32	30	286	−37.3	37	29	277	−42.7	.....	23	284	−36.4	43
11,000	30	248	−42.8	.....	31	246	−44.2	.....	31	249	−42.8	.....	30	246	−44.8	.....	29	238	−48.3	.....	21	245	−43.7	.....
12,000	30	214	−50.0	.....	31	212	−50.0	.....	30	214	−50.0	.....	30	212	−51.7	.....	29	204	−53.1	.....	21	211	−50.5	.....
13,000	29	183	−56.5	.....	31	182	−54.8	.....	29	183	−56.7	.....	30	181	−56.9	.....	28	174	−55.8	.....	20	180	−56.1	.....
14,000	29	156	−62.0	.....	30	155	−59.3	.....	28	156	−62.4	.....	30	154	−60.7	.....	27	149	−57.8	.....	16	154	−61.3	.....
15,000	27	133	−65.9	.....	30	132	−63.2	.....	24	132	−66.6	.....	30	132	−63.7	.....	27	127	−59.5	.....	15	130	−63.6	.....
16,000	26	112	−67.4	.....	30	112	−64.3	.....	23	112	−69.1	.....	30	112	−65.3	.....	25	108	−59.6	.....	12	111	−64.9	.....
17,000	23	95	−66.7	.....	29	95	−63.5	.....	21	94	−68.2	.....	29	94	−64.3	.....	25	92	−59.3	.....	9	94	−64.5	.....
18,000	23	81	−64.2	.....	27	81	−61.4	.....	18	80	−66.4	.....	28	80	−62.6	.....	22	78	−58.6	.....	5	80	−62.8	.....
19,000	13	69	−62.1	.....	25	69	−59.0	.....	14	68	−64.1	.....	23	68	−60.5	.....	15	67	−57.4	.....	.....	.....	.....	.....
20,000	7	58	−59.7	.....	21	59	−56.8	.....	13	57	−62.1	.....	14	58	−58.5	.....	7	57	−56.1	.....	.....	.....	.....	.....
21,000	5	49	−58.0	.....	12	50	−54.9	.....	7	49	−60.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22,000	.....	.....	.....	.....	5	43	−53.0	.....	5	41	−58.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Observations taken about 4 a. m. 75th meridian time.

[1] Observations began at these new radiosonde stations between July 6 and 14, 1939.
[2] First 10 days were airplane observations.
[3] Navy.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

Number of observations refers to pressure only as temperature and humidity data are missing for some observations at certain levels, also, the humidity data are not used in daily observations when the temperature is below −40° C.

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during July 1939*

[Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second (superior figures indicate number of observations)]

Altitude (meters) m. s. l.	Abilene, Tex. (537 m.)		Albuquerque, N. Mex. (1,554 m.)		Atlanta, Ga. (302 m.)		Billings, Mont. (1,095 m.)		Boise, Idaho (850 m.)		Brooklyn, N. Y. (15 m.)		Brownsville, Tex. (7 m.)		Buffalo, N. Y. (220 m.)		Burlington, Vt. (132 m.)		Charleston, S. C. (18 m.)		Cheyenne, Wyo. (1,873 m.)		Chicago, Ill. (192 m.)		Cincinnati, Ohio (157 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	168	3.6[3]	116	1.3[31]	279	1.4[21]	83	0.2[31]	294	3.7[31]	180	5.0[26]	142	6.4[20]	253	3.1[21]	255	1.1[31]	171	2.7[31]	184	1.5[31]	123	1.1[31]	263	0.5[31]
500	.....	.....	.....	.....	273	2.1[31]	276	0.4[31]	.....	.....	204	3.6[30]	151	7.5[10]	262	3.8[31]	235	1.7[31]	180	3.8[31]	.....	.....	173	1.2[31]	280	1.2[31]
1,000	163	4.9[31]	.....	.....	281	2.8[31]	254	1.4[31]	300	3.2[31]	255	3.2[29]	164	6.3[27]	257	4.6[31]	249	3.2[31]	222	3.2[25]	.....	.....	224	2.7[28]	281	2.2[30]
1,500	162	4.6[31]	.....	.....	294	3.1[31]	257	3.0[31]	310	2.6[31]	276	3.9[29]	162	5.7[23]	259	3.6[30]	258	4.0[31]	246	3.5[22]	.....	.....	274	2.7[28]	290	2.7[29]
2,000	164	4.4[21]	174	1.0[31]	309	3.8[29]	255	5.1[31]	280	1.4[31]	290	4.2[28]	144	4.8[26]	268	3.9[29]	266	5.0[30]	269	3.5[19]	184	1.7[31]	307	4.0[29]	297	3.8[27]
2,500	166	3.7[31]	228	0.9[31]	323	4.3[25]	252	8.5[29]	256	3.1[31]	285	5.3[27]	128	4.2[19]	269	4.2[29]	257	5.0[26]	280	4.0[18]	197	1.3[31]	310	6.2[21]	311	4.9[28]
3,000	168	3.6[30]	292	1.2[31]	329	4.5[24]	250	11.3[26]	245	4.9[31]	293	6.6[26]	130	4.4[15]	282	4.2[21]	267	5.0[21]	285	4.0[17]	237	1.5[31]	316	8.5[17]	310	6.7[23]
4,000	178	2.9[26]	348	1.6[30]	336	5.0[24]	255	13.1[22]	247	7.0[29]	286	7.8[21]	109	3.9[18]	287	4.8[14]	294	4.2[17]	327	4.7[13]	278	3.9[30]	316	10.6[15]	308	9.9[20]
5,000	188	2.7[23]	49	1.7[27]	344	5.8[20]	250	15.6[20]	249	8.8[26]	302	8.8[14]	.....	.....	.....	.....	.....	.....	330	3.8[10]	263	5.7[26]	.....	.....	321	12.6[12]
6,000	208	2.8[19]	29	1.0[23]	328	4.6[17]	256	12.9[13]	262	9.0[22]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	268	5.9[18]	.....	.....	.....	.....
8,000	213	2.2[15]	100	1.7[19]	308	5.5[12]	.....	.....	252	11.3[19]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	274	10.7[16]	.....	.....	.....	.....
10,000	169	0.9[12]	178	1.1[13]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	258	15.2[14]	.....	.....	.....	.....
12,000	155	1.5[10]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	254	17.6[10]	.....	.....	.....	.....

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.)		Fargo, N. Dak. (283 m.)		Greensboro, N. C. (271 m.)		Havre, Mont. (766 m.)		Houston, Tex. (21 m.)		Huron, S. Dak. (393 m.)		Las Vegas, Nev. (570 m.)		Little Rock, Ark. (82 m.)		Medford, Oreg. (410 m.)		Miami, Fla. (10 m.)		Minneapolis, Minn. (261 m.)		Nashville, Tenn. (194 m.)		New Orleans, La. (19 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	147	1.5[31]	182	0.8[30]	229	1.2[30]	243	1.4[21]	175	2.1[30]	171	1.6[21]	263	2.4[31]	178	0.0[31]	308	2.5[30]	137	2.8[29]	251	1.3[29]	281	1.1[21]	227	0.9[21]
500	.....	.....	210	1.6[30]	208	1.9[28]	.....	.....	185	3.6[30]	177	1.9[21]	.....	.....	179	0.7[31]	311	2.7[30]	163	3.0[28]	224	2.1[29]	287	1.7[31]	211	2.1[31]
1,000	.....	.....	227	2.4[26]	229	2.9[30]	243	2.1[31]	190	2.2[30]	199	2.3[31]	193	2.7[31]	211	1.0[29]	322	2.6[30]	172	2.6[27]	219	3.3[29]	273	1.8[31]	244	1.7[21]
1,500	164	1.0[31]	269	2.9[29]	250	3.3[30]	248	2.6[31]	187	1.8[27]	226	2.7[21]	198	3.0[31]	281	2.1[30]	292	1.4[30]	201	1.8[27]	229	3.5[29]	280	1.8[28]	289	1.7[29]
2,000	103	0.5[31]	291	4.9[26]	264	4.3[25]	256	5.3[31]	172	1.8[26]	254	3.7[30]	198	3.4[31]	289	3.0[29]	216	2.9[30]	216	1.4[26]	267	4.4[28]	319	3.3[25]	311	2.3[26]
2,500	85	1.3[31]	292	7.2[28]	285	5.2[24]	254	7.0[31]	143	1.5[23]	269	5.8[30]	211	3.3[31]	309	3.5[28]	213	5.3[30]	202	1.2[23]	279	5.7[25]	332	4.8[23]	338	1.9[24]
3,000	85	1.8[31]	294	8.9[27]	286	6.4[24]	248	8.9[29]	139	2.4[20]	270	8.2[29]	216	4.2[31]	324	2.9[27]	220	6.8[29]	196	1.5[23]	301	7.7[23]	330	6.3[22]	356	3.0[23]
4,000	80	2.0[29]	294	11.0[25]	303	7.7[16]	257	10.6[24]	67	1.4[16]	277	10.9[29]	212	5.6[31]	338	3.5[27]	223	7.5[26]	174	1.8[20]	299	10.5[16]	331	6.9[20]	48	2.4[22]
5,000	90	1.9[25]	299	13.3[22]	304	8.4[11]	262	12.4[19]	40	3.5[10]	278	12.6[27]	220	5.0[29]	352	3.8[24]	230	9.9[24]	161	2.3[17]	302	12.5[13]	321	7.7[13]	46	3.9[20]
6,000	160	2.2[20]	298	14.6[20]	309	9.2[10]	263	12.4[13]	.....	.....	286	13.6[25]	230	4.5[29]	340	4.6[22]	235	11.1[21]	156	2.7[16]	302	13.0[11]	316	7.3[14]	73	2.4[14]
8,000	88	1.6[20]	294	16.4[18]	.....	.....	266	11.0[12]	.....	.....	281	16.3[21]	241	4.9[25]	286	2.8[15]	242	19.5[13]	87	3.1[10]	.....	.....	.....	.....	.....	.....
10,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	282	18.2[14]	239	7.0[20]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	290	16.2[11]	239	10.0[20]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	240	9.8[17]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5. p. m. (E. S. T.) during July 1939*—Continued

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)		Oklahoma City, Okla. (402 m.)		Omaha, Nebr. (306 m.)		Reno, Nev. (1,346 m.)		St. Louis, Mo. (170 m.)		Salt Lake City, Utah (1,294 m.)		San Diego, Calif. (15 m.)		San Juan, P. R. (16 m.)		Sault Ste. Marie, Mich. (198 m.)		Seattle, Wash. (14 m.)		Spokane, Wash. (603 m.)		Washington, D. C. (10 m.)		Winslow, Ariz. (1,488 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	277	5.0[26]	177	3.3[33]	136	2.0[31]	274	1.2[21]	213	1.5[31]	226	0.5[31]	263	4.0[31]	82	7.7[31]	282	3.6[31]	277	2.3[31]	219	2.6[31]	243	1.0[31]	245	1.5[31]
500	266	3.6[20]	175	3.6[31]	153	2.2[21]	-----	-----	209	1.1[31]	-----	-----	271	2.1[31]	93	9.4[31]	287	5.5[31]	271	1.3[31]	-----	-----	249	2.4[21]	-----	-----
1,000	248	2.9[29]	183	4.0[31]	182	1.7[31]	-----	-----	237	1.4[31]	-----	-----	291	1.5[30]	105	8.3[30]	282	5.5[31]	238	1.9[30]	221	3.5[31]	265	2.4[31]	-----	-----
1,500	233	2.0[27]	192	3.1[31]	220	2.6[30]	260	1.2[21]	278	2.4[30]	223	0.7[31]	278	0.7[20]	108	7.7[30]	280	5.1[31]	221	2.4[29]	222	4.0[31]	267	4.4[29]	-----	-----
2,000	207	2.9[27]	210	3.0[31]	248	3.1[28]	244	1.5[31]	286	5.1[26]	191	1.0[31]	199	0.8[25]	100	7.8[27]	293	5.7[28]	229	3.2[27]	217	4.8[30]	282	5.6[26]	242	1.7[31]
2,500	203	3.6[27]	207	3.1[31]	278	4.9[27]	232	2.2[31]	294	7.1[21]	209	1.9[31]	198	2.0[30]	93	7.6[25]	296	5.9[25]	229	3.3[24]	227	5.7[29]	295	6.9[22]	230	1.9[31]
3,000	214	3.9[26]	204	3.3[31]	284	6.2[26]	232	3.5[31]	312	8.1[19]	219	2.5[31]	200	2.4[30]	90	7.4[25]	301	8.0[23]	223	4.2[21]	235	7.0[28]	293	7.9[21]	234	0.9[31]
4,000	211	4.6[25]	203	3.1[29]	289	7.4[26]	235	5.2[29]	323	9.7[14]	228	4.0[29]	172	3.0[28]	94	6.3[22]	295	9.5[23]	243	6.8[18]	241	9.7[24]	-----	-----	221	1.9[29]
5,000	217	6.6[24]	201	1.6[28]	300	9.0[26]	236	7.8[27]	-----	-----	236	6.8[26]	166	3.8[22]	92	6.8[18]	301	10.4[20]	244	8.5[16]	247	10.8[23]	-----	-----	173	1.3[22]
6,000	221	6.3[23]	205	2.6[25]	305	9.7[25]	235	8.3[26]	-----	-----	238	10.2[21]	173	2.0[13]	73	5.7[15]	304	10.7[15]	253	7.9[12]	277	9.8[12]	-----	-----	121	2.1[20]
8,000	249	4.6[17]	167	0.7[23]	292	10.3[24]	254	10.5[23]	-----	-----	248	10.5[15]	-----	-----	90	3.8[11]	-----	-----	-----	-----	-----	-----	-----	-----	145	2.5[19]
10,000	-----	-----	272	2.2[22]	293	11.7[20]	268	14.0[16]	-----	-----	-----	-----	-----	-----	77	1.3[10]	-----	-----	-----	-----	-----	-----	-----	-----	215	3.7[17]
12,000	-----	-----	292	3.2[19]	284	12.4[16]	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	234	6.3[15]
14,000	-----	-----	254	2.1[16]	297	9.6[13]	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	214	5.2[11]

TABLE 3.—*Maximum free-air wind velocities (M. P. S.), for different sections of the United States based on pilot balloon observations during July 1939*

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station
Northeast [1]	26.3	SW	1,180	14	Hartford, Conn.	32.0	NW	4,320	2	Albany, N. Y.	34.5	WSW	10,420	24	Cleveland, Ohio.
East-Central [2]	26.0	N	2,260	14	Nashville, Tenn.	38.0	WSW	4,280	1	Richmond, Va.	28.2	WNW	6,330	14	Knoxville, Tenn.
Southeast [3]	21.3	NNW	2,500	15	Birmingham, Ala.	31.6	NNW	3,890	15	Birmingham, Ala.	27.6	NNW	8,310	11	Atlanta, Ga.
North-Central [4]	36.4	N	2,480	15	Sault Ste. Marie, Mich.	39.8	NNW	2,660	15	Sault Ste. Marie, Mich.	53.2	WSW	10,350	21	Huron, S. Dak.
Central [5]	31.0	W	911	12	Des Moines, Iowa.	38.4	NNW	3,110	14	Evansville, Ind.	30.6	SW	10,350	24	Moline, Ill.
South-Central [6]	31.4	NNE	1,840	11	Del Rio, Tex.	25.1	N	2,830	9	Oklahoma City, Okla.	32.8	W	7,010	19	Little Rock, Ark.
Northwest [7]	32.4	NW	1,900	20	Billings, Mont.	51.8	WSW	3,070	10	Pocatello, Idaho.	44.0	WSW	8,260	20	Billings, Mont.
West-Central [8]	34.2	SSE	2,500	9	Ely, Nev.	48.5	S	5,000	12	Ely, Nev.	84.0	W	19,710	6	Redding, Calif.
Southwest [9]	27.3	S	1,770	8	Albuquerque, N. Mex.	24.8	WSW	3,810	2	Sandberg, Calif.	53.8	WSW	13,900	1	Las Vegas, Nev.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.
[3] South Carolina, Georgia, Florida, and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.
[7] Montana, Idaho, Washington, and Oregon.
[8] Wyoming, Colorado, Utah, northern Nevada, and northern California.
[9] Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

TABLE 4.—*Mean altitudes and temperatures of significant points identifiable as tropopauses during July 1939, classified according to the potential temperatures (10-degree intervals between 290° and 409° A.) with which they are identified (based on radiosonde observations)*

Potential temperatures	Atlanta, Ga.			Bismarck, N. Dak.			Charleston, S. C.			Denver, Colo.			El Paso, Tex.			Joliet, Ill.			Miami, Fla.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature
290-299																					
300-309																					
310-319																					
320-329				6	9.7	−44.0										2	9.1	−37.5			
330-339	1	11.0	−48.0	16	11.1	−50.5				6	10.9	−46.5				11	10.2	−41.2	2	12.0	−59.0
340-349	17	12.1	−53.1	13	12.1	−54.3	7	12.0	−51.1	10	12.0	−52.5	10	12.8	−58.6	20	11.7	−50.7	7	12.0	−51.4
350-359	18	13.4	−60.4	12	13.2	−59.8	11	13.6	−62.0	8	13.4	−60.0	14	13.9	−63.6	13	13.4	−59.5	21	13.5	−60.5
360-369	18	14.8	−66.5	5	14.2	−63.0	5	14.6	−65.0	7	14.6	−65.3	13	15.1	−69.9	6	13.8	−58.2	6	14.6	−65.2
370-379	5	15.5	−69.0	8	14.9	−63.6	9	15.7	−70.3	7	13.0	−65.7	5	15.8	−72.4	7	14.8	−62.7	9	15.6	−68.0
380-389	13	16.1	−69.4	4	15.4	−64.2	3	16.0	−69.0	3	15.6	−65.0	4	16.5	−73.2	6	15.5	−64.3	5	16.1	−68.4
390-399	4	16.6	−70.8	5	16.0	−65.0	4	17.1	−72.0				2	17.0	−72.5	3	15.9	−63.0	6	16.9	−69.0
400-409	3	17.3	−69.0							2	17.0	−68.0	3	17.4	−70.7	3	17.0	−66.3	5	17.4	−71.2
Weighted means		14.3	−62.9		12.8	−56.5		14.5	−62.3		13.2	−58.9		14.7	−66.6		12.9	−54.6		14.5	−63.3
Mean potential temperature (weighted) [1]		364.7			353.7			364.9			358.4			378.5			357.2			367.1	

Potential temperature	Nashville, Tenn.			Oakland, Calif.			Oklahoma City, Okla			Omaha, Nebr.			Sault Ste. Marie Mich.			Washington, D. C.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature
290-299																		
300-309																		
310-319													2	8.6	−44.5			
320-329	2	10.4	−47.5										12	9.6	−44.1			
330-339	4	10.8	−44.8	10	10.5	−43.7	1	10.9	−46.0	8	11.0	−47.8	24	11.1	−52.4	7	10.2	−42.1
340-349	18	11.4	−47.3	25	11.5	−48.6	9	12.1	−52.3	22	12.2	−54.0	17	12.2	−55.8	11	12.3	−55.7
350-359	23	13.1	−57.1	10	13.2	−56.9	17	13.4	−60.3	13	13.4	−60.2	10	13.1	−58.4	5	13.4	−61.4
360-369	16	14.5	−65.3	14	14.4	−63.4	12	14.9	−67.8	17	14.3	−63.1	6	14.1	−63.3	4	13.3	−54.5
370-379	11	15.4	−68.5	10	15.0	−64.0	9	15.5	−68.8	11	15.1	−65.3	3	14.4	−61.3	2	14.0	−52.5
380-389	6	15.8	−66.2	9	15.7	−65.1	6	16.1	−69.0	10	16.0	−66.8	12	15.0	−61.0			
390-399	5	16.6	−68.6	5	16.2	−66.2	5	16.6	−68.4	9	16.3	−65.4	2	15.6	−63.0	2	16.1	−67.0
400-409	3	17.1	−68.3	5	16.8	−65.0	1	17.7	−74.0	3	16.7	−65.0	2	16.2	−64.5	1	16.6	−63.0
Weighted means		13.7	−58.9		13.4	−56.7		14.4	−63.4		13.9	−60.2		12.3	−55.1		12.6	−54.2
Mean potential temperature (weighted) [1]		360.8			361.7			365.1			363.8			349.9			353.2	

[1] Applies to tables for previous months also.

RIVERS AND FLOODS

[River and Flood Division, MERRILL BERNARD, in charge]

BY BENNETT SWENSON

The precipitation during the month of October 1939 was decidedly deficient over much of the country and the majority of the rivers were unusually low at the close of the month.

No floods were reported with the exception of one in the lower Rio Grande on October 12–14. This flood resulted from heavy rains on the 10th to 11th which were centered principally over the tributaries which enter the lower Rio Grande from the Mexican side.

These rains resulted in a sharp increase of the stages in the river from Rio Grande City, Tex., downstream. Flood stages were exceeded slightly at a few points including Rio Grande City and Mercedes, Tex., where crest stages of 21.6 and 21.4 feet, respectively, were reached. However, very little water overflowed on the American side of the river, and no appreciable damages resulted.

Table of flood stages, October 1939

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
West Gulf Drainage					
Rio Grande:	*Feet*			*Feet*	
Rio Grande City, Tex.	21	12	13	21.6	12
Mercedes, Tex.	21	13	14	21.4	14